Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of	)	
	)	
The Establishment of Policies and	)	
Service Rules for the Non-Geostationary	)	IB Docket No. 01-96
Satellite Orbit, Fixed Satellite Service in the	)	
Ku Band	)	

REPLY COMMENTS OF TELEDESIC LLC

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SUMMARY

Teledesic is pleased that a majority, four of the six applicants for licenses to operate Ku-band NGSO FSS systems, have expressed their support for the third spectrum sharing option proposed by the Commission – "Avoidance of In-Line Interference Events." Teledesic believes that Commission adoption of this model will ensure that systems that become operational have access to sufficient spectrum to support economically viable operations, encourage efficient use of spectrum, and avoid a government-imposed solution that constrains design flexibility. None of the Commission's other proposals or the hybrid proposals offer the flexibility and efficiency associated with the Avoidance of In-Line Interference Events model. In support of the Avoidance of In-Line Interference Events model, Teledesic proposes a definition of in-line events that will guarantee that unacceptable interference will not hinder operations of systems during in-line events.

In addition to its support for the in-line events sharing model, Teledesic urges the Commission to adopt a blanket licensing approach for Ku-band NGSO FSS earth stations and in so doing to avoid adoption of antenna reference patterns or off-axis e.i.r.p. limits. Finally, Teledesic supports the Commission's proposal not to impose a strict financial qualification standard for this service in favor of allowing the market to determine the viability of competing Ku-band NGSO FSS Systems.

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REPLY COMMENTS OF TELEDESIC LLC

Teledesic LLC hereby replies to the comments filed regarding the Notice of Proposed Rulemaking released on May 3, 2001, setting forth various Commission proposals for policies and service rules for non-geostationary satellite orbit, fixed-satellite service (NGSO FSS) in the Ku band.[1] The comments reveal that a majority of the Ku-band NGSO FSS applicants support the adoption of the third spectrum sharing option proposed by the Commission – "Avoidance of In-Line Interference Events." Teledesic encourages the Commission to adopt this model in the interests of promoting efficient use of spectrum, ensuring that all systems that become operational have access to sufficient spectrum to support economically viable operations, and avoiding a government-imposed solution that constrains design flexibility. Neither the Commission's other proposals, nor the hybrid proposals from some commenters, offer the flexibility and efficiency associated with the Avoidance of In-Line Interference Events model. In support of the Avoidance of In-Line Interference Events model, Teledesic proposes a definition of in-line events that will guarantee that unacceptable interference will not hinder operations of systems during in-line events.

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[1] Notice of Proposed Rulemaking, FCC 01-134 (rel. May 3, 2001).

In addition to its support for the in-line events sharing model, Teledesic urges the Commission to adopt a blanket licensing approach for Ku-band NGSO FSS earth stations and in so doing to avoid adoption of antenna reference patterns or off-axis e.i.r.p. limits. Finally, Teledesic supports the Commission's proposal not to impose a strict financial qualification standard for this service in favor of allowing the market to determine the viability of competing Ku-band NGSO FSS Systems.

I. THE COMMISSION SHOULD ADOPT THE "AVOIDANCE OF IN-LINE INTERFERENCE EVENTS" MODEL SUPPORTED BY A MAJORITY OF KU-BAND NGSO FSS SYSTEM PROPONENTS.

Teledesic is pleased that four of the six applicants that submitting comments in this proceeding – Skybridge, Boeing, Denali, and Teledesic – urged the Commission to adopt its third proposed spectrum sharing option – Avoidance of In-Line Interference Events. As Teledesic explained in its comments of July 5, 2001, the third approach outlined in the NPRM is far more spectrum-efficient than Option 1 (Flexible Band Segmentation) or Option 2 (Dynamic Band Segmentation), and will leave operators with much more design flexibility than Option 4 (Homogenous Constellations). The in-line events model leaves all operators free to use all of the spectrum for as much of the time as possible, requiring coordination and mitigation measures only during in-line events. Although some commenters raised concerns about Option 3, those concerns prove upon examination to be unfounded; moreover, the alternatives to Option 3 offered by Boeing, Hughes, Denali and Virtual Geo are all inferior to Option 3 in important ways.

A. Concerns Raised about Successful Coordination of In-Line Events are Unfounded.

The only two system proponents that do not support the Avoidance of In-Line Events model, Virtual Geo and Hughes, maintain that mitigating in-line events will be more difficult for their systems for various reasons. However, neither of their arguments are availing because they are based on misunderstandings about how an Avoidance of In-Line Events model would actually work.

Virtual Geo opposes the Avoidance of In-Line Events model based in part on a mistaken belief that all operational systems would be required to employ satellite diversity to avoid in-line events.[2] Indeed, as observed by Skybridge in its comments,[3] the NPRM itself incorrectly assumes such a requirement.[4] However, satellite diversity would not be mandated were this model of spectrum-sharing adopted. Indeed, the default rule for operating systems would be frequency isolation for those limited periods where satellites from different constellations are in an in-line configuration. This would in effect involve employing the band segmentation methods contemplated in Options 1 and 2, but only when in-line events occur. Although operating systems would be free to adopt coordination agreements employing satellite diversity, this would be entirely voluntary and by definition only occur only when such a model was preferable to employing frequency isolation. Moreover, if some sharing technique is truly

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[2] Virtual Geosatellite LLC Comments at 24 "([I]mposing an affirmative satellite diversity requirement on all systems would be inappropriate)".

[3] Skybridge Comments at 17 n. 36.

[4] NPRM ¶ 31 "(We also recognize that requiring satellite diversity would increase the technical complexity of NGSO FSS systems.").

superior to both frequency isolation and satellite diversity, Option 3 gives the operators the flexibility to adopt that technique.[5]

Hughes's concern about the Avoidance of In-Line Events being disadvantageous for "full-mesh" system as compared with gateway-driven systems is a red herring. Both types of systems would employ numerous end-user terminals that could be affected simultaneously during an in-line event. Although users in a "full-mesh" system may not be in direct contact with a gateway, their use of spectrum is certainly controlled by some form of network control center via communication from the satellite. Given that the in-line events are predictable, it would indeed be possible for the network control center to constrain the spectrum usage during an inline event. Similarly, the users in a "full-mesh" network would have a mechanism in place for performing a handover from one satellite to another. Since the inline events are as predictable as normal satellite handovers, the same mechanism for normal satellite handovers can be used to initiate handovers due to inline events. It is also notable that both of the Hughes Ku-band system designs rely on the use of satellite diversity to avoid interference with the GSOs, so these systems are by definition capable of simultaneously handing off a large number of users in order to operate in these bands.

B. The Other Proposals for Spectrum Sharing Would Introduce Delay, Inefficiency, and Reduced Capacity for Ku-band NGSO FSS Systems.

Even though four of the six applicants favor the adoption of Option 3, the initial round of comments yielded three or four alternative proposals, from Boeing, Hughes, Virtual Geo,

[5] Virtual Geo also premises some of its criticism of Option 3 on the assumption that it involves uniform limits on transmitter power, as suggested by Skybridge. Fortunately, however, Option 3 does not require such limits; transmit power is just one of many factors that affects the size of the avoidance angle. Once Skybridge's proposal for a uniform avoidance angle is jettisoned in favor of a definition of in-line events based on ITU-R Recommendation S.1323-1, the case for limits on transmitter power evaporates, as does this aspect of Virtual Geo's criticism.

and possibly Denali.[6] It should be noted that Boeing appears to prefer Option 3 to the alternative advanced in Boeing's own comments, which raises some question about whether the proposed alternative is really being proposed. In any event, each of these alternatives is inferior to Option 3 in important ways.

1. Boeing. Boeing proposes an alternative hybrid plan that incorporates aspects from the original four options. Under this plan each system would be given primary status in a selected portion of each sub-band, and secondary status in all other portions of the band. Primary portions would be selected on a "first to operate" basis. Operators would be permitted to "pool" their primary spectrum assignments by agreement.

This proposal has no advantages and some disadvantages when compared with Option 3, where systems would be given primary status to all of the spectrum with a coordination requirement only during in-line events. Take for example, the case of just two operational systems. Under Boeing's proposal, each system would be primary in half the band and secondary in the other half of the band. Presumably, however, each system would use its secondary spectrum at all times except during in-line events. Hence, no purpose is served by labeling one of the systems with a secondary status, except during in-line events. Even then, Boeing proposes that the systems should coordinate during in-line events, which again is the same result as with Option 3, and it has the disadvantage of confusing the point that normally a secondary system is not entitled to coordinate with a primary system. Moreover, the Boeing alternative would seem to require each system to use the same primary spectrum all of the

[6] Denali explicitly supports Option 3, but then proposes "a slight modification," Denali at 2. Frankly, Teledesic does not understand precisely what Denali is proposing, but to the extent Denali is suggesting that homogeneity should be the primary sharing technique for HEOs while frequency isolation and satellite diversity are the primary sharing techniques for LEOs and MEOs, the modification seems to be similar to the alternative advanced by Virtual Geo, with similar flaws.

time and throughout the globe, which would deprive operators of flexibility they may need in order to accommodate differing spectrum plans in different countries. Similarly, the spectrum "pooling" aspect of Boeing's proposal offers no advantage over Option 3; under either sharing plan, two fully compatible systems would each use all of the spectrum all of the time, while two systems unable to operate co-frequency at all times would divide the spectrum or otherwise coordinate during in-line events. As noted above, Boeing supports Option 3 and hence not even Boeing suggests any advantages to this "hybrid" alternative; Teledesic can find none either.

2. Hughes. The Hughes proposal, by contrast, is asserted by Hughes to be superior to any of the alternatives presented by the Commission. Hughes believes that neither the Commission nor any applicant is currently in a position to endorse a particular sharing option, and that therefore the applicants should continue to engage in technical discussions. This proposal, coming as it does after almost three years of desultory meetings among the applicants, is practically self-refuting.

Hughes offers only one reason to think that negotiations now will be any more successful than negotiations have been over the last three years: Commission assistance in surmounting ITAR[7] difficulties with the exchange of technical information. Without in any way denigrating the seriousness of the ITAR issues, there is simply no reason to believe that a speedy agreement will result even if those issues are completely resolved, which is by no means guaranteed. On the contrary, the Commission's experience over the last several years with informal working groups attempting to resolve processing rounds would tend to suggest that

[7] International Traffic in Arms Regulations, 22 C.F.R. Parts 120-130 ("ITAR"). The ITAR regulations implement Section 38 of the Arms Export Control Act, 22 U.S.C. 2778, which authorizes the President to control the export and import of defense articles and defense services. The statutory authority of the President to promulgate regulations with respect to exports of defense articles and defense services was delegated to the Secretary of State by Executive Order 11958, as amended (42 Fed. Reg. 4311).

nothing but more delay will result. The inherent and insoluble problem with such negotiations is that they give any one company the practical ability to forestall deployment by all the others. All too often, an entrenched incumbent has been willing to play that card. If ITAR were repealed tomorrow, industry agreement would likely be years away, and the applicants simply do not have years to waste.

Moreover, it is not at all clear that the type of industry agreement Hughes is contemplating would be in the public interest. Hughes seems to be hoping that negotiations will end up with at least some operators receiving "specifically tailored" assignments.[8] While Hughes touts this as an advantage, one need look no further than the 1.6/2.4 GHz "Big LEO" bands to see that it has obvious drawbacks. Any band plan that is "specifically tailored" to particular system proposals runs the risk of becoming obsolete or at best inefficient once those proposals are abandoned or modified. Because it is clear to a moral certainty that not all of the systems described in the pending applications will actually be deployed, let alone deployed as currently proposed, any band plan comprising "specifically tailored" assignments is likely to result in wasted spectrum. Hence, just as the Big LEO band plan is not the most efficient or equitable way for the two existing Big LEO systems to operate, any band plan premised on the deployment of seven Ku-band NGSO FSS systems will not be the most efficient or equitable way for the one, two, or three successful applicants to operate in the Ku band. Accordingly, even if Commission involvement to overcome ITAR obstacles were the magic bullet Hughes supposes, and even if all applicants were strongly motivated to achieve a consensus quickly, the approach advocated by Hughes is far more likely to result in inefficiencies than in the speculative efficiencies Hughes suggests.

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[8] Hughes Comments at 7.

3. *Virtual Geosatellite.* Virtual Geo indicates that although it strongly favors adoption of Option 4 – Homogenous Constellations, it would be prepared to accept a compromise whereby the available spectrum is divided equally between homogeneous constellations employing a "virtual geostationary satellite orbit" and other NGSO FSS systems with a small amount of spectrum left in reserve as "growth zones."[9] This hybrid proposal, thus, calls for one of the seven proposed systems, not coincidentally Virtual Geo's, to receive half of the available spectrum, while the rest of the available spectrum would have to satisfy the needs of all other operating systems. The problem with this approach is obvious. Virtual Geo is no more deserving than any other applicant of a 50% share of available spectrum despite its claims that the VGSO model is the most efficient and sharing-compatible model.[10] The VGSO sharing model proposed by Virtual Geo is an oxymoron as there are no systems on the horizon with which Virtual Geo could currently share and so its claims to efficiency are premised on mere conjecture.[11]

Moreover, despite the king-sized portion of the spectrum that Virtual Geo claims for itself, it is not at all clear that Virtual Geo's proposal would be an improvement on Option 3 even for Virtual Geo. Option 3 would merely require Virtual Geo to move to half of the spectrum during an in-line event involving two satellites. Thus, according to Virtual Geo's own

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[9] Virtual Geosatellite Comments at 8, 36-38.

[10] Virtual Geo bases its claim of spectrum efficiency on the highly optimistic assertion that up to 30 Virgo-like "global" systems can share this same spectrum, although they reduce this number by at least two when they recognize that smaller terminals might be desirable. It should also be noted that the Virgo filing lays claim to one and a half of these "global" systems.

[11] Granting Virtual Geo's request and allocating half of the NGSO Ku-band spectrum to Virtual Geo and "VGSO" systems also would ignore the fact that other non-US NGSO systems that have filed in the Ku-band would have ITU priority over any future VGSO systems filed in the US or elsewhere. Such a decision would place the US Ku-band NGSO systems at a distinct competitive disadvantage by precluding them from using half of the Ku-band spectrum while non-US Ku-band NGSO systems would maintain access to the full spectrum through their ITU priority.

simulations, for more than 99% of the time Virtual Geo would have access to all of the spectrum, for some small percentage of time (< 1%) Virtual Geo would have access to half of the spectrum, and for some very small percentage of time (< 0.01%), Virtual Geo would have less than half the spectrum.[12] Hence, the advantages of Virtual Geo's proposal, even for Virtual Geo, are dubious; the disadvantages for the other applicants are patent.

II. THE COMMISSION SHOULD ADOPT A DEFINITION OF "IN-LINE" EVENTS PREMISED ON ITU-R RECOMMENDATION S.1323-1.

In its comments, Teledesic proposed a methodology for establishing a definition of in-line events premised on establishing acceptable levels of interference between multiple operating systems.[13] Once acceptable levels of interference are defined, simulations can be run using the specific characteristics of the systems involved to derive avoidance angles, which when implemented by the affected systems guarantee that unacceptable interference will not hinder operations of either system. These avoidance angles then become the complete definition of an in-line event between two systems.

Teledesic urges the Commission to begin its formulation of a definition of an in-line event by first considering how to measure acceptable aggregate interference levels between two or more systems. To this end the Commission should consider ITU-R Recommendation S.1323-1, *recommends 3.1,* which defines an aggregate interference time allowance of 10% of the time allowance for the BER specified in the short-term performance objectives for two or more systems. Although this aggregate interference includes both GSO FSS and NGSO FSS interfering networks, more recently, Working Party 4A has agreed to a 10% allowance solely

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[12] Appendix 1 of Virtual Geosatellite Comments

[13] Teledesic Comments at 4-7.

for NGSO interference (the same applying to GSO FSS systems).[14] This modification, has been endorsed in a U.S. contribution to the ITU-R Working Party 4A,[15] but has not been yet formally incorporated into Recommendation ITU-R S.1323-1.

Teledesic proposes that a 10% aggregate allowance applicable to the interference from NGSO FSS systems be adopted. When only two systems are involved, single-entry interference will equal aggregate NGSO FSS interference. Thus, an in-line event is contemplated whenever the 10% allowance is exceeded by any of the two systems. When three or more NGSO systems are involved, the 10% aggregate interference still applies but at that point it becomes highly desirable to define coordination triggers for each pair of systems. While ITU studies continue to consider the issue of how to apportion the 10% interference allowance, Teledesic proposes a 7% time allowance when three systems are involved (two interfering sources) and a 5% time allowance when four or more systems are involved (three or more interfering sources).

In contrast to Teledesic's proposal, which is premised on ITU-R Recommendation S.1323-1, Skybridge proposes to use the C/N value that causes sync loss rather than the lowest C/N value that corresponds to the minimum BER performance objective.[16] Although SkyBridge notes that synchronization and availability are almost equivalent for the types of systems under consideration, they also recognize that the sync loss C/N value is typically 1 dB to 4 dB less than the C/N required for the minimum BER performance objective. Teledesic urges the

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[14] "Preliminary Draft Revision of Recommendation ITU-R S.1323-1", Revision 1 to Document 4A/TEMP/74 (May 1, 2001).

[15] "Proposed Modifications to Draft Revision of Recommendation ITU-R S.1323," U.S. Submission to the September/October 2000 meeting of Working Party 4A, Document 4A/32 (September 18, 2000).

[16] Skybridge Comments at Annex 1.

Commission to proceed on the basis of the accepted findings on interference levels adopted in ITU-R Recommendation S.1323 rather than defining a new level of acceptable interference based on sync loss. Moreover, it should be noted that adopting the ITU-R Recommendation S.1323 approach should reduce SkyBridge's concerns over systems with very low link margins.

III. THE COMMISSION'S BLANKET LICENSING APPROACH FOR EARTH STATIONS SHOULD NOT MANDATE A REFERENCE ANTENNA PATTERN OR OFF-AXIS E.I.R.P. DENSITY LIMITS.

The Commission's proposal to adopt blanket licensing of earth stations in the Ku-band NGSO FSS received unanimous support. Such support is not surprising given the fact that blanket licensing is unquestionably the most practical and efficient method by which to regulate earth stations and will increase the availability of Ku-band service to the public.

Only two of the commenters, Skybridge and Virtual Geo, disagreed with the Commission's proposal not to mandate off-axis equivalent isotropically radiated power ("e.i.r.p.") limits for NGSO FSS earth stations. Skybridge maintains that the Commission should apply the WRC-2000 off-axis e.i.r.p. limits and accompanying regulations (such as grandfather provisions) to GSO FSS earth stations and NGSO FSS earth stations alike.[17] However, Skybridge incorrectly asserts that to do otherwise would "conflict with international agreements to which the United States is a party."[18] The WRC-2000 regulations to which Skybridge alludes, however, were established solely for GSO FSS earth stations emissions and no such rules have ever been established for NGSO FSS earth stations. Indeed, even at the level of ITU recommendations, there is no consensus that limits are necessary for NGSO FSS.

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[17] Skybridge Comments at 22.

[18] *Id.*

Virtual GEO argues in its comments that "adoption of uniform earth station antenna patterns, coupled with off-axis e.i.r.p. limits will greatly enhance the ability of homogeneous NGSO FSS systems to share spectrum."[19] Although off-axis e.i.r.p. limits may make sense for VGSO-type systems, like Virtual Geo, they are unnecessary for other NGSO FSS systems, and will only increase the cost of user terminals and create additional regulatory burdens for operators without offering significant improvement in system sharing.

IV. THE COMMISSION SHOULD AVOID THE IMPOSITION OF FINANCIAL QUALIFICATION STANDARDS AND ALLOW MARKET FORCES TO DETERMINE VIABILITY.

The initial round of comments produced the usual controversies regarding financial qualifications and milestones. Boeing proposes to defer the financial qualification finding until 12 months after licensing, effectively converting the financing of the system into a milestone.[20] Hughes proposes that the Commission revive the pre-licensing qualifications test that it used to use for satellites, but suggests that NGSO applicants should only have to demonstrate current assets equal to 25% of estimated system cost, rather than 100%.[21] Both proposals are flawed. In Teledesic's view, the winnowing process that these proposals are meant to achieve would be much better facilitated through market forces. Teledesic therefore urges the Commission to reject the Boeing and Hughes proposals and refrain from adopting strict financial qualification standards in favor of allowing the market to establish the viability of competing Ku-band NGSO FSS Systems. The Hughes proposal, requiring 25% of system cost to be "in the bank" at the time of licensing, moves in the right direction by recognizing that NGSO constellations are

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[19] Virtual Geo Comments at 42.

[20] Boeing Comments at 15.

[21] Hughes Comments at 27.

much more expensive and complex than traditional geostationary networks, and that the capital and other requirements for an NGSO FSS network can only be satisfied through an extensive global partnership. It is for this reason that Hughes proposes to drop the current assets threshold from 100% of system cost to 25% of system cost. Unfortunately, the Hughes proposal fails to address the chief difficulty with the Commission's traditional "current assets" test, which is that cash on hand has been a very poor predictor of success in deploying a system.

Examples of the "false positives" and "false negatives" that arise from the application of the traditional measure of financial qualifications abound. However, perhaps the best recent example of a "false positive" is TRW's proposed Big LEO system which was never launched despite the fact that TRW sailed through the financial qualifications test based on its healthy balance sheet.[22] In sharp contrast, despite its great success, EchoStar would have been a "false negative" under the standard financial qualifications test because it did not begin the licensing process with a robust balance sheet. These two examples illustrate what should by now be clear to most observers of today's satellite business: the ability of a proposed satellite system to successfully convince wary investors and the Commission of the viability of a proposed system is a far better predictor of the skill and determination that will be necessary to implement a proposed system and deliver on promises of commercial success to investors and service in the public interest than the ability to produce a conglomerate's healthy balance sheet at the outset of a proceeding.

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[22] In its order granting TRW a license in January 1995, the Commission found that "TRW has submitted substantial evidence to show that it has current assets and operating income sufficient to construct and launch its system, and provided an unequivocal statement that it intends to spend the funds necessary to construct the proposed system." *Application of TRW Inc. for Authority to Construct, Launch and Operate a Low Earth Orbit Satellite System in the 1610-1626.5 MHz/2483.5-2500 MHz Band*, 10 FCC Rcd. 2263 ¶ 6 (1995).

Moreover, it is important to think of pre-licensing requirements as requirements that must be satisfied not just at the time of licensing, but at the time of filing an application. In an environment in which satellite licensing routinely takes three years or more, it may sound reasonable to require that a system proponent raise 25% of its funding prior to licensing. It is to be hoped, however, that three-, four-, and five-year licensing delays are not with us permanently, and that we can once again return to the days when a space station license could be granted six months after the application was filed. In that environment, a requirement that 25% of the necessary capital be "in the bank" at the time of licensing would be tantamount to restricting satellite licenses to large multinational corporations, who will in many cases be incumbents. That would not be in the public interest.

The Boeing proposal to make the accumulation of investment capital a new milestone begins to address the chief deficiency in the Hughes proposal, by implicitly acknowledging that financing such a large infrastructure project takes time. Unfortunately, the Boeing proposal fails to recognize that there will often be no business necessity to raise the full 100% of system cost in the first twelve months after licensing. On the contrary, the satellite construction process, which is often only just getting under way twelve months after licensing, typically requires progress payments at specified intervals right up to the time the last satellite is launched and the system is brought into commercial use. Thus, the Boeing milestone approach would accelerate the capital requirements for what is already an extremely formidable capital accumulation challenge. This would place the Commission in the position not just of *predicting* which projects will succeed, but rather of *making success more difficult.* Whatever, the Commission does on financial qualifications and milestones, it must strive not to make deployment more difficult than it already is.

CONCLUSION

For the foregoing reasons, Teledesic urges the Commission to adopt an "in-line" events model for spectrum sharing among Ku-band NGSO FSS systems, to define an in-line event based on ITU-R Recommendation S.1323-1, to adopt blanket licensing for earth stations without mandating a reference antenna pattern or off-axis e.i.r.p. density limits, and to avoid the imposition of a strict financial qualification standard for this service.

Respectfully submitted,

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CERTIFICATE OF SERVICE

I hereby certify that the foregoing "Reply Comments of Teledesic LLC" was served on the below-listed parties by first-class U.S. mail postage prepaid on this 6th of August 2001.

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